

PGEOG31100/ PHYS31100 – Introduction to Fluid Mechanics Spring 2016

Professor Haydee Salmun

Class Meetings:

Tuesday and Friday, 2:10-3:25, Room 1028 Hunter North

Professor Salmun Contact Information:

Office Department of Geography, Room 1035 Hunter North

E-mail hsalmun@hunter.cuny.edu (*)

Tel. 212-772-4159

Office Hours: Tuesday, 4:00 – 5:00, *please make an appointment*

* **Note:** the best way to contact me is via email – (1) You must include the course name or number in your subject line (2) You must include your entire name in your email (3) I try to answer all email messages within 24 hours. Allow for a 48 hour delay on the weekends.

Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice. Updates will be posted regularly on BlackBoard.

General Description – 3 credits

This course covers the basic principles of fluid mechanics at an introductory but detailed level. Topics include statics, forces on plane and curve surfaces, kinematics of fluid motion, integral and differential representation of conservation of mass, the first Law of Thermodynamics, Bernoulli's equation, dimensional analysis, and elementary viscous flow. Frictional losses, simple pipeline analysis and steady channel flow are covered. Understanding of the physical phenomena is stressed and vector notation is used whenever suitable.

The course will provide the foundations for courses that students will encounter in physics, earth sciences and environmental pursuing careers in many branches of applied physics and engineering (mechanical engineering, civil and environmental engineering, biomedical engineering, biophysics, atmospheric sciences, oceanography, earth and planetary sciences), such as hydrology, hydrogeology, aerodynamics, geophysical fluid dynamics, propulsion systems, chemical reactor design, biophysics and dynamics of chemical processes.

Goals and Objectives

- To make students view fluids based on physical laws.
- To enable students to analyze fluids phenomena using physical laws and mathematics.
- To make students link real fluid phenomena with descriptive/analytical work in class.
- To stimulate students' interest in understanding the complex world of fluids.
- To provide students with critical thinking skills to explain and solve scientific problems.

Learning Outcomes

At the end of the semester, students successfully completing this course will be able to

- acquire fundamentals related to fluids, including concepts of mass, momentum, and energy conservation;
- determine pressure in a static liquid; write manometer equations; calculate the magnitude and location of point forces due to fluid pressure on a plane surface;
- apply properly the Bernoulli Equation to determine how changes in fluid velocity influence fluid pressure and solve flow problems;
- use conservation of mass, energy and momentum with a control volume to analyze or design a flow system;
- use dimensional analysis to analyze and solve fluid mechanics problems;
- apply dimensional analysis techniques to explain experimental data;
- recognize, describe and explain laminar and turbulent flows;
- associate fundamentals of fluid mechanics to real-world applications.

Prerequisites

PHYS 121 or PHYS 120 and MATH 155 (Calculus I and II) or Permission of the Instructor

Students with one semester of calculus may be able to take this course while they are taking the second semester of calculus. Basic physics recommended or/and permission of instructor.

Please Note: These are guidelines, when in doubt please contact me. I expect that in class I will go over the math needed in this course and will not let that hamper our progress in understanding basic concepts, working out problems and being able to achieve the objectives of this course.

Course Materials

Textbook: “*A Brief Introduction to Fluid Mechanics*”, 5th Edition; Donald F. Young, Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch.
ISBN: 978-0470-59679-1 Paperback (528 pages) January 2011

Cost of text book: \$192.95 (paperback) or \$62.50 for E-text, directly from Wiley regular web site or it can be purchased from Amazon.com for \$145.08 – new – and for less if used (approximately \$98). E-text on Amazon is available from approximately \$45.

Additional readings will be provided during the semester as applications of the theoretical concepts to real world problems are encountered.

Grading Guideline:

- 30% from two midterm exams
- 25% from homework assignments
- 10% from class participation
- 35% from final exam

List of Topics (following Textbook's Table of Contents)

1. Introduction
2. Fluid Statics
3. Elementary Fluid Dynamics — The Bernoulli Equation
4. Fluid Kinematics
5. Finite Control Volume Analysis
6. Differential Analysis of Fluid Flow
7. Similitude, Dimensional Analysis, and Modeling
8. Viscous Flow in Pipes

Exams

The exams will be based on the material covered in class, in the textbook and concepts that are learned through the homeworks. The exam dates are CLEARLY posted in the syllabus of the course. The dates are set from day one and cannot be changed. Three exams will be given, two in-class midterm exams and one final exam. See the syllabus for exam dates and information about which chapters will be covered.

About examinations and grades:

- a) Grades follow Hunter's grading system, which can be found at <http://catalog.hunter.cuny.edu/content.php?catoid=18&navoid=2010>
- b) Examinations are 1 hour and 15 minutes for the mid-term and 2 hours for the final exam and must be turned in promptly. If you arrive late, you lose that time.
- c) Make-up exams are ONLY available in extreme cases, and students must provide documentation of the reason for missing the exam (medical or other forms)
- d) I will automatically agree to the CR-NCR option only if the conditions stated in the CR-NCR form are satisfied: all course work has been completed and you earned grades such that you accumulate at least 50 points total in the course (this includes HWs+exams+extra, if you earned any). Students on probation are not eligible for this option.

Attendance

Attendance is required at all lectures. Up to two unexcused absences from lectures will be tolerated. Each unexcused absence after the maximum allowable will result in a decrease of 5% from the student's final grade.

HELPFUL INFORMATION

My Teaching Philosophy: My goal in teaching is to help students in becoming confident and responsible professionals and to make this experience an enjoyable one. My approach to teaching involves being a facilitator in the learning process as opposed to being the authoritarian lecturer at the front of the room with a "one-way information transfer" style. I understand and respect individual differences in learning and do my best to promote learning in the classroom by working with individual differences rather than against them. At the same time, I wish to impart technical skills and a sense of responsibility by encouraging students to play the role of professionals in the classroom.

I expect students to put their best effort in this course. This involves participating in the in-class exercises, reading the assigned material, doing the homework, editing when necessary until they are clear and correct, and preparing for quizzes and exams.

Lecture: I will spend part of the lecture time explaining the key concepts of fluid mechanics and devote time to solution of problems. You are expected to devote time outside the classroom to understand the concepts, work out problems and review questions. I expect that lectures will help you solve the problems on the quizzes and exams.

Finally: It is important to start with a good study habit. Consistency is the key. Forming study groups is extremely helpful. Use my office hours and any other resource available to you throughout the semester. Make progress steadily as the material in this course cannot be understood the night before the exam. Concentrate on understanding rather than ‘regurgitating’. Put out your best effort everyday.

The following are useful tips to do well in this or any class:

- Attend class and take detailed notes.
- Read the assigned material in the text (or other) *before* coming to class.
- Re-write your notes as soon as possible after class. This will allow you to fill in the details still fresh in your memory, and prepare questions for the next time the class meets.
- Test yourself by answering the questions in the book and in class.
- Carefully study the diagrams and charts in the book and in the lectures.

As with all courses at Hunter College:

Academic Dishonesty: Please be advised that plagiarism, dishonesty, or cheating in any portion of the work required for this course will be punished to the full extent allowed according to Hunter College regulations.

Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The College is committed to enforcing CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures.

See the following report by the Hunter College Senate for more details:

<http://www.hunter.cuny.edu/senate/assets/Documents/Hunter%20College%20Policy%20on%20Academic%20Integrity.pdf>

ADA Policy

In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, Hunter College is committed to ensuring educational parity and accommodations for all students with documented disabilities and/or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical, Physical, and/or Learning) consult the Office of AccessABILITY, in Room E1214B, to secure necessary academic accommodations. For information and assistance: (212)772-4857 or (212)650-3230.

A Tentative Syllabus is provided below – an updated version will be available at the beginning of the semester from the course website and blackboard (look for file schedule.pdf). Syllabus gets updated throughout the semester, as needed. Check regularly for updates.

TENTATIVE COURSE SCHEDULE (*) – PGEOG31100/PHYS31100 SPRING 2016
INTRODUCTION TO FLUID MECHANICS –Prof. Haydee Salmun, hsalmun@hunter.cuny.edu

Week #/Date		Topic/Chapter (from textbook)	Assignments	Notes
Week 1 Jan 29		Introduction: Overview of course structure, standards and expectations. Review of mathematical fundamentals. Overview of general physical properties of fluids		
Week 2 Feb 2, 5		Chapter 1: Fluid properties, viscosity, elasticity, surface tension, dimensions, units.	HW# 1: Problems from Chapter 1: 3, 4, 6, 11, 16, 22, 23, 27, 28, 33, 40	
Week 3 Feb 9		Chapter 1 Discussion of Problems		HW 1 due
Feb 12		No Class: President's Day – College Closed		
Week 4 Feb 16, 19		Chapter 2: Fluid Statics: pressure, hydrostatic forces, buoyancy, pressure variations.	HW# 2: Problems from Chapter 2: 4, 8, 9, 10, 12, 15, 16, 17, 18, 24, 27, 46 + prob. assigned in class	
Week 5 Feb 23, 26		Chapter 3: Elementary Fluid Dynamics - The Bernoulli Equation. Basic physics: Newton's laws.	HW# 3: Problems from Chapter 3: 1 through 6, 8, 16, 22, 26, 27, 31, 46, 51	HW 2 due
Week 6	Mar 1	Chapter 3: Review of Bernoulli's equation and applications – Problems		
	Mar 4	*Midterm Exam I* Chapters 1, 2, 3	HW# 4: Problems from Chapter 4: 1, 6, 8, 10, 11, 15, 26, 27, 28, 29	HW 3 due
Week 7 Mar 8, 11		Chapter 4: Kinematics description of fluid flow.		
Week 8 Mar 15, 18		Chapter 4: More fluid kinematics, Reynolds Transport Theorem, continuity equation.	HW# 5: Problems from Chapter 5: 1, 3, 4, 9, 11, 12, 13, 14, 16, 19, 21, 25, 28, 29, 31, 39, 51, 53, 64, 68	HW 4 due
*NOTE: on March 23 the College follows Friday's				
Week 9	Mar 22, 23*	Chapter 5: Finite control volume analysis		
	Friday 25	No Class: President's Day – College Closed		
Week 10 Mar 29 – April 13		Chapter 6: Differential analysis of fluid flow.	HW# 6 (a): Problems from Chapter 6: 1 – 10	HW 5 due (worth 20 points)
Week 11	April 5	Chapter 6: Differential analysis of fluid flow.		
	April 8	*Midterm Exam II*	HW# 6 (b): Problems	HW 6 (a)

		Chapters 4, 5, parts of 6	from Chap 6: 11 – 15	due
Week 12 April 12, 15	Chapter 6: Differential analysis of fluid flow.		HW# 7: Problems from Chapter 6: TBD	
Week 13 April 19	Chapter 6: Differential analysis of fluid flow.			HW 6 (b) due
April 22, 26, 29	Spring Break		Spring Break	Spring Break
Week 14 May 3, 6	Chapter 7 - Dimensional analysis and application to modeling.			
Week 15 May 10, 13	Chapter 7 - Dimensional analysis and application to modeling.		HW# 8: Problems from Chapter 7: Problems 5 – 10	HW 7 due
Week 15 May 17 – Last Class	Chapter 7 - Dimensional analysis and application to modeling. General Review		All HWs must be in before the final exam for credits – (full or partial)	
Final Exam	Week May 23 – 27; exact date To Be Determined (by College)			

Homework assignments are due the week following the time they are assigned, unless otherwise stated. Late assignments will not be given full marks.

(* This schedule will be updated as needed, please check for updates on our website/blackboard regularly.